HURRICANE HARVEY UPDATE

ENGINEERING DEPARTMENT

October 17, 2017

PRESENTATION OUTLINE

- DRAINAGE SYSTEM OVERVIEW
- RECENT RECORD STORMS
- HURRICANE HARVEY STORM
- IMPACTS ON THE CITY
- ENGINEERING RESPONSE
- ONGOING EFFORTS AND MOVING FORWARD
- QUESTIONS

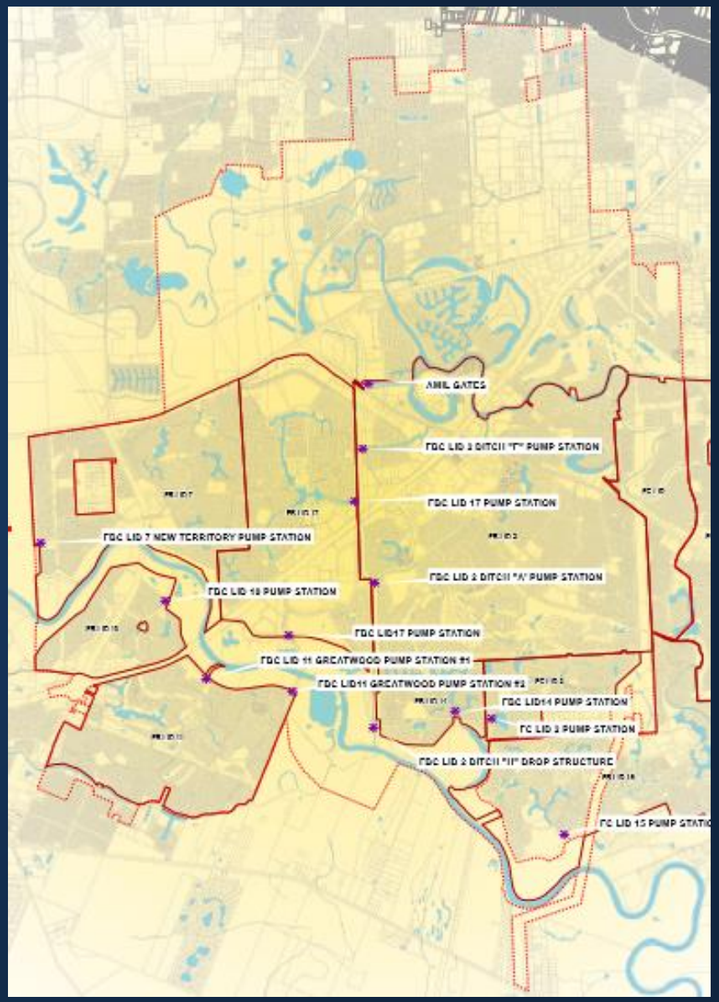
CITY’S DRAINAGE SYSTEM OVERVIEW

- City’s drainage system operates different in the North and the South side
- Both systems utilize streets, inlets and conduits to convey runoff into receiving channels and detention facilities and pumps
- The North system, a gravity system, drains freely and directly/indirectly to Oyster Creek
- In the South system, the streets, inlets and conduits convey water to the LID ditches, channels and detention ponds which drain by gravity or pumping into the Brazos River

CoSL DRAINAGE SYSTEM

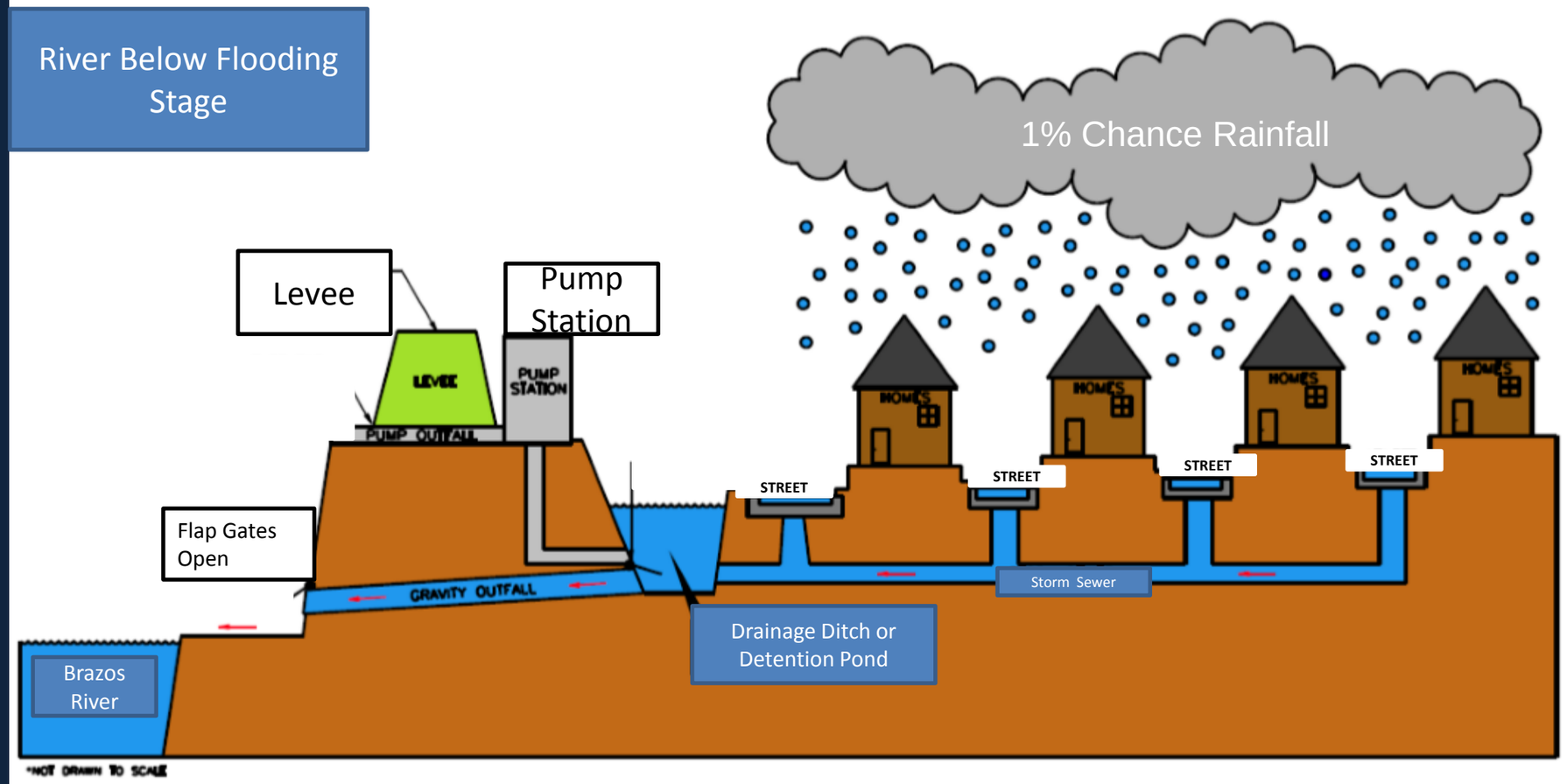
SYSTEM COMPONENTS

City’s Storm water system and LIDs detention ponds, channels and pump stations work in conjunction with one another



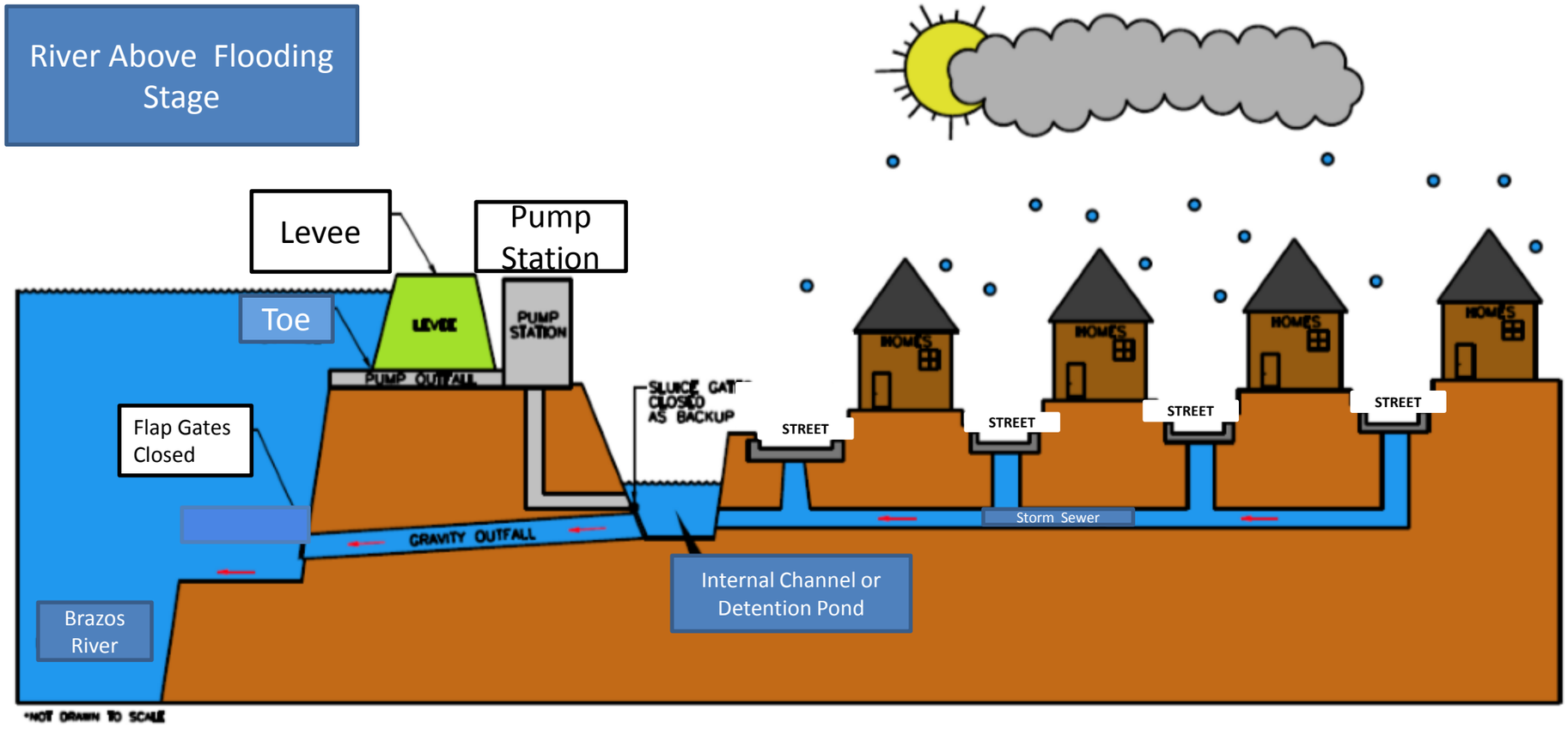
http://cosl.maps.arcgis.com/apps/presentation/index.html?webmap=c405430835c4437a870290b849e108d6

NORMAL OPERATIONS
1% Chance (100-YR) Internal Rainfall

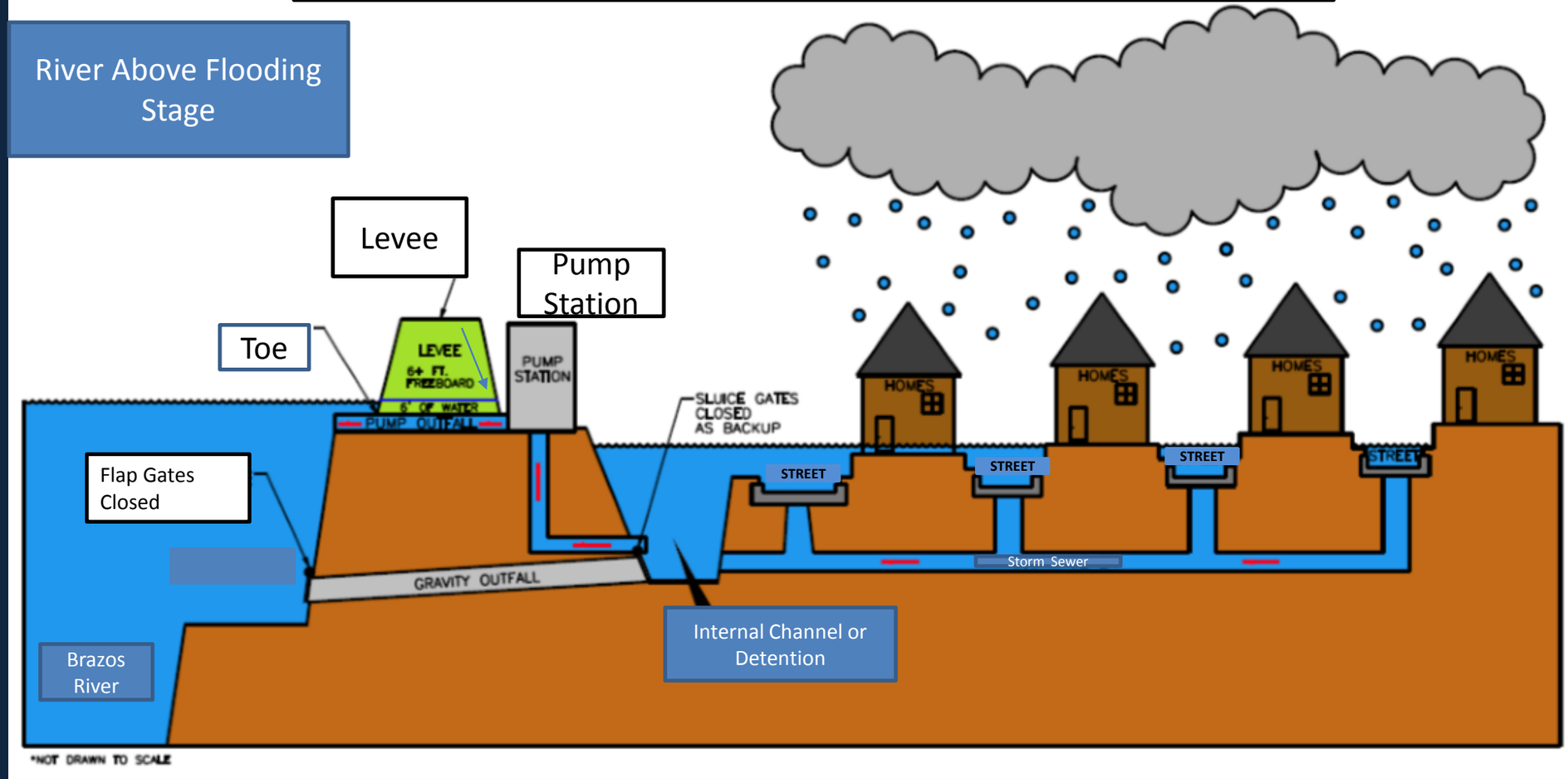


NORMAL OPERATIONS
BRAZOS RIVER AT FLOOD STAGES

River Above Flooding Stage

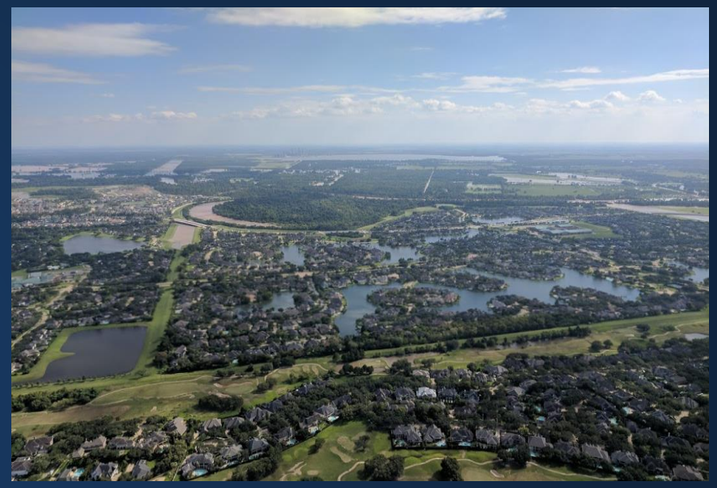


COINCIDENTIAL EVENT OPERATIONS
1% Chance (100 YR)



DRAINAGE SYSTEM OVERVIEW

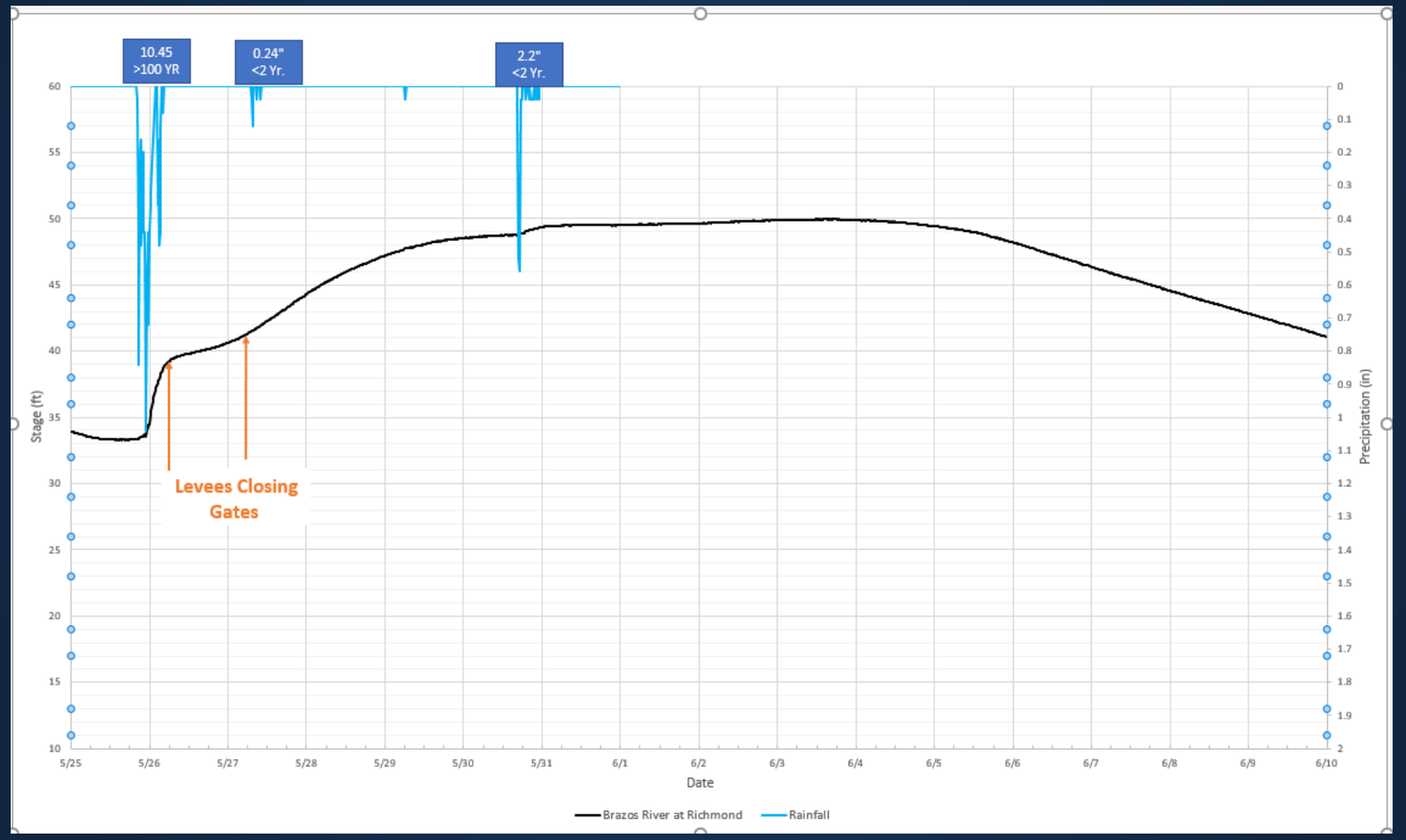
- SYSTEM COMPONENTS
  - Brazos River
  - Oyster Creek
  - Bullhead Bayou
  - Ditch A-22
  - Steep Bank Creek
  - Ditch H, Ditch H Bypass
  - Amil Gates,
  - Pump Stations



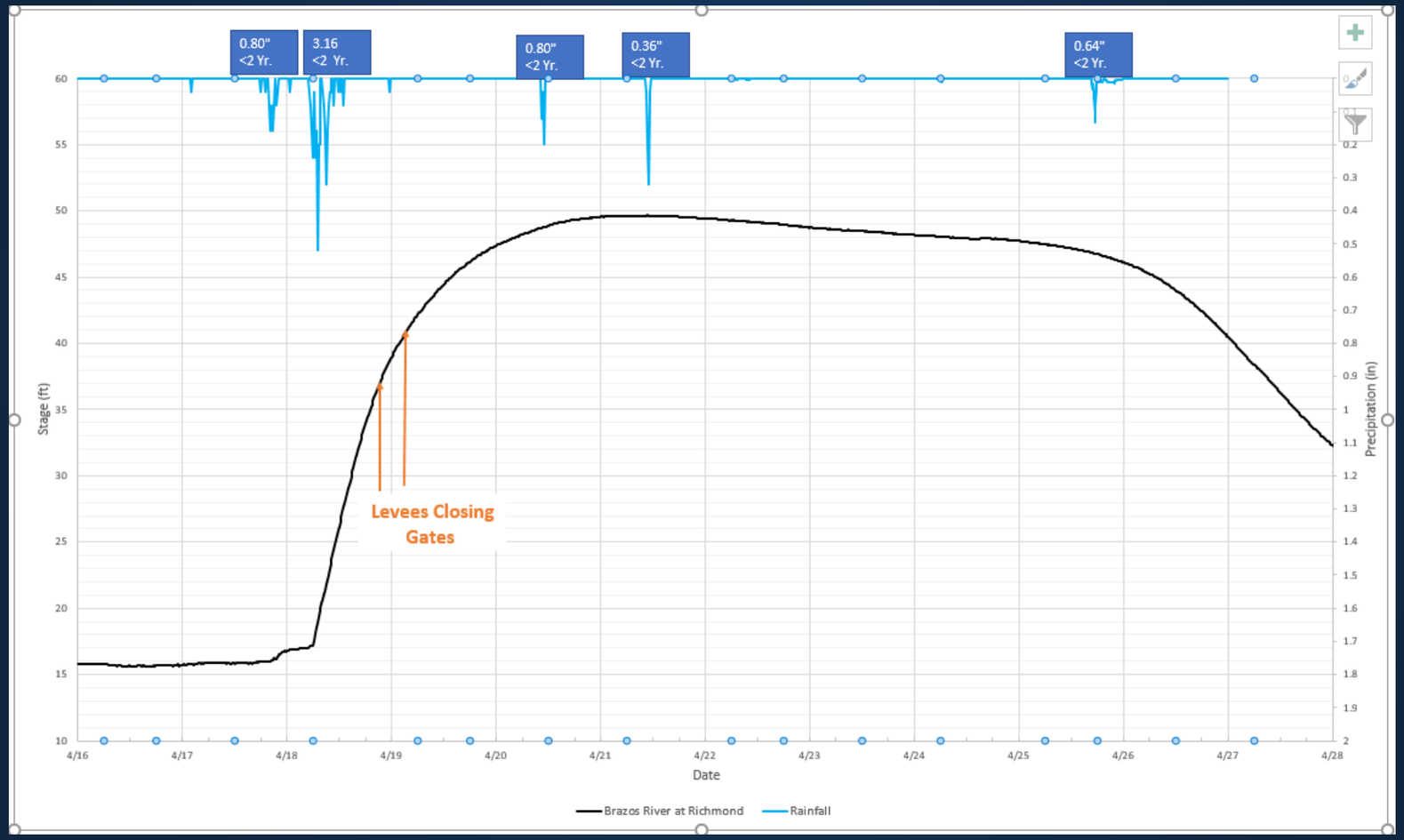
RECENT RECORD STORMS

- 2015 Memorial Day Event
- 2016 Tax Day Event
- 2016 Memorial Day Event
- 2017 Hurricane Harvey

RECENT RECORD STORMS
Memorial Day - 2015



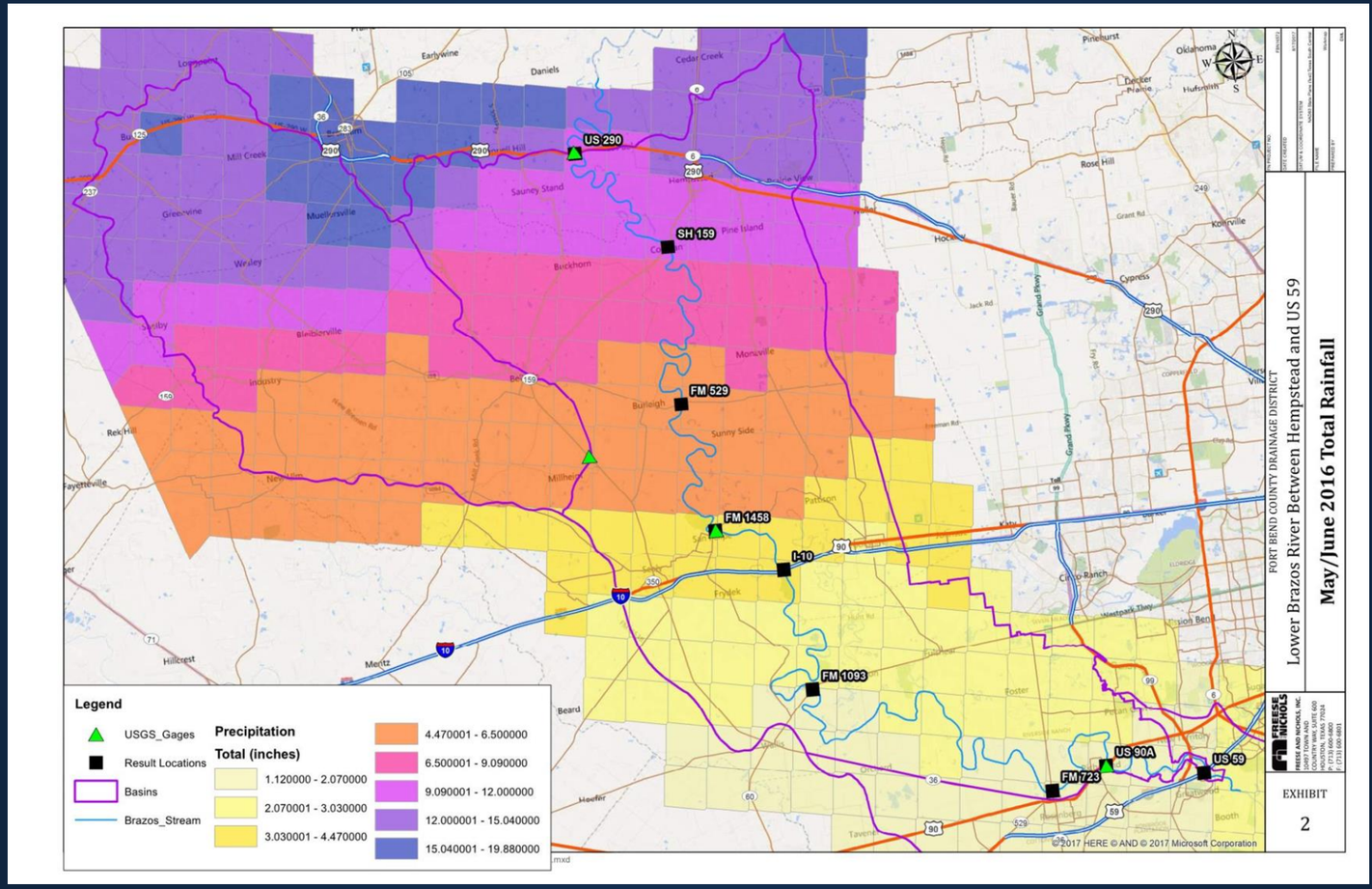
RECENT RECORD STORMS
Tax Day - 2016



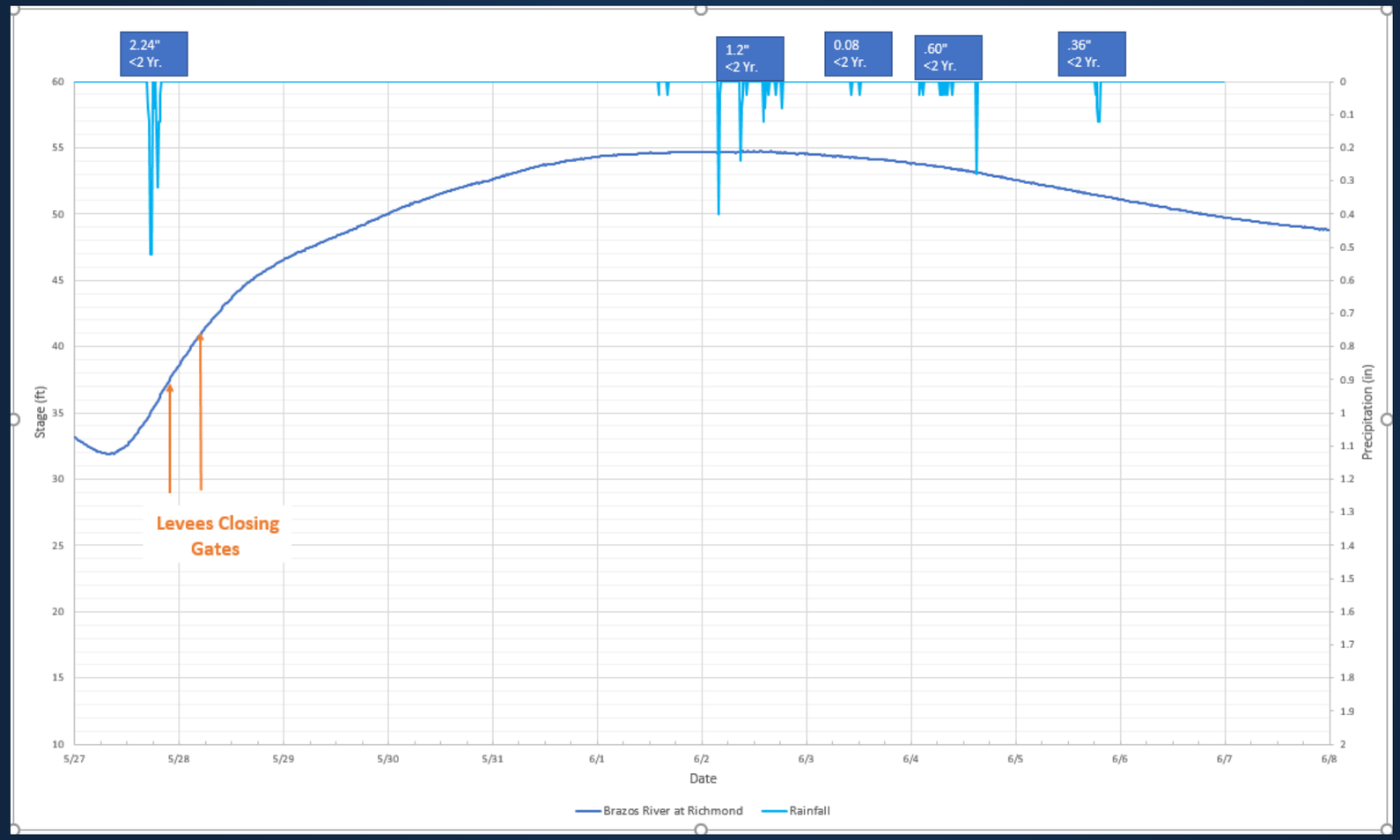
RECENT STORMS
Memorial Day 2016

- Major rainfall within the Brazos River watershed
    - 19+” of rain in Brenham area
    - River crested at Richmond gauge elevation 54.7 (new record)
    - River crested on June 2, 2016
    - Rainfall in Sugar Land totalled – less than 1”

RECENT STORMS
Memorial Day 2016



RECENT RECORD STORMS
Memorial Day - 2016



DIFFERENCE BETWEEN RECORD STORMS

- 2015 Memorial Day Event
  - Rain fell across the entire lower Brazos basin
  - 7.4” of rain in CoSL by May 26, 2015 (morning)
  - LIDs Gates closed on May 26, 2015 (afternoon)
  - 3.6” of rain pumped after May 28, 2015

- 2016 Tax Day Event
  - Majority of heavy rainfall fell outside of the Brazos basin
  - 9.8” of rain in CoSL by Apr. 19, 2016 (timing?)
  - LIDs Gates closed on Apr. 19, 2016 (timing?)
  - 1.8” pumped after Apr. 19, 2016

- 2016 Memorial Day Event
  - Local rainfall not near as severe as previous events
  - LIDs started closing gates after May 28, 2016
  - 2.24” of rain pumped after June 1, 2016
  - River at crest at 54.7’ (Historical high elevation)

HURRICANE HARVEY

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HARVEY: RECORD STORM

- **The most extreme rain event in US History (Washington Post).**

Gage Location	30 min	60 min	2 hour	3 hour	6 hour	12 hour	24 hour	2 days	4 days
Ditch A Outfall	1.4	2.8	4.1	4.5	5.4	6.4	12.0	19.9	29.5
Amil Gates	1.8	3.4	4.4	4.9	6.1	7.2	13.5	21.9	32.0
Oyster Creek @ Dam 2	1.6	2.4	3.5	4.0	5.0	7.8	13.2	20.8	30.6
Ditch B @ Dulles	1.9	2.8	4.6	5.2	8.0	11.7	14.9	24.8	34.4
Siphon B @ Ditch B	2.0	3.1	5.4	5.9	9.0	12.8	16.1	25.4	34.9
Jane Long Lake @ Contry Club	1.4	2.7	4.5	5.0	7.0	11.2	15.1	23.8	33.8
East Sugar Creek Ditch @ Sugar Creek	2.0	3.1	5.0	5.7	8.5	12.4	16.0	25.6	35.2
Ditch 90A @ Eldridge	1.5	2.0	3.1	3.5	4.9	8.6	13.4	21.3	31.4
Ditch A-22 @ Burney	1.6	2.6	3.8	4.4	5.5	9.0	14.6	23.0	32.1
Covington Ditch @ Jess Pirtle	1.5	2.0	3.1	3.4	4.9	8.9	13.3	21.3	30.9
Oyster Creek @ SH 6	2.1	3.6	4.8	5.5	6.9	8.1	14.6	23.4	33.1

Table 3
Approximate Return Frequencies for Peak Rainfall Depths for Various Duration in Fort Bend County

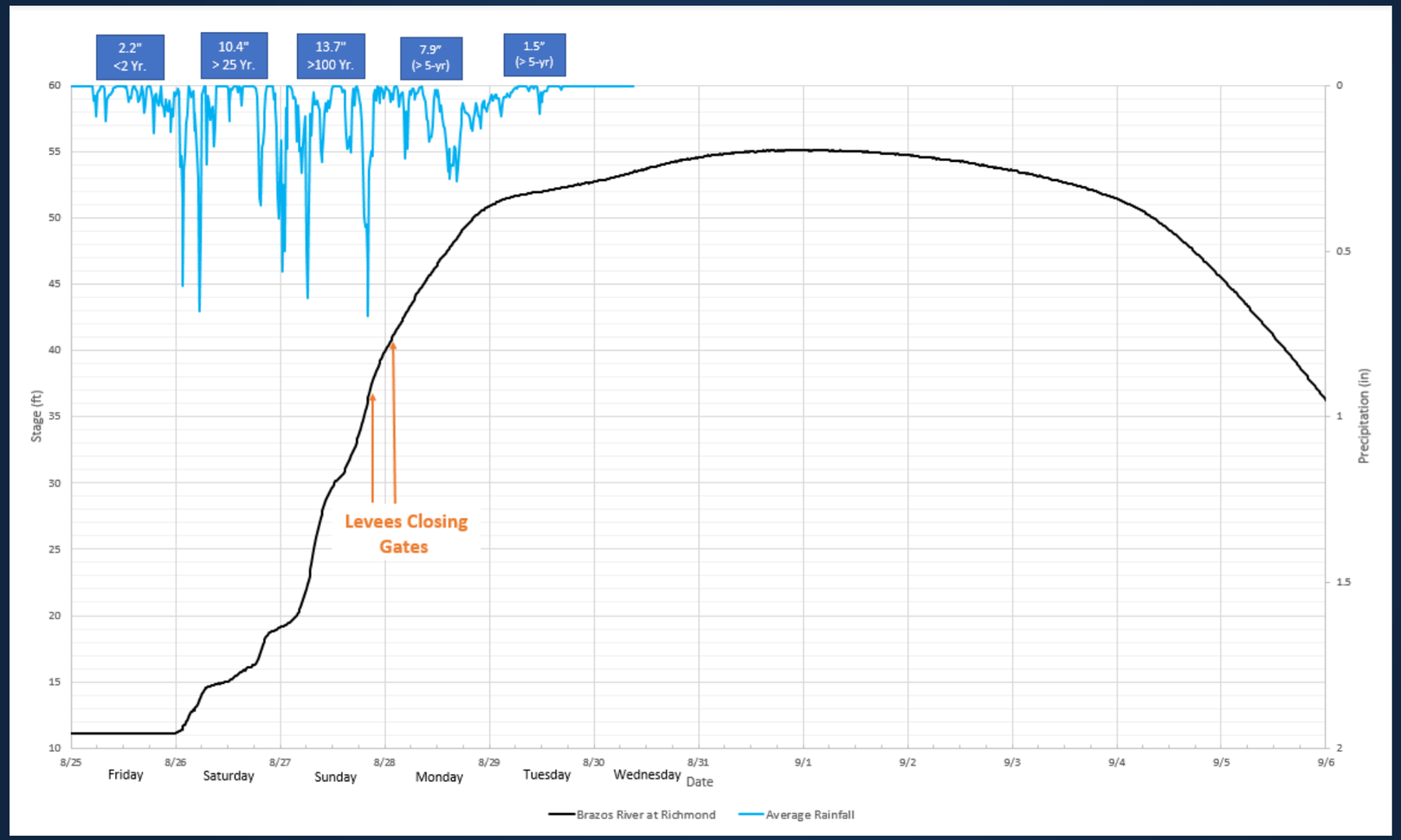
Duration	Return Frequency (years) 2	5	10	25	50	100	500
30 minutes	1.9	2.3	2.7	3.0	3.5	3.8	4.6
60 minutes	2.3	2.7	3.3	3.8	4.2	4.6	5.5
2 hours	2.8	3.1	4.3	4.9	5.4	6.1	7.4
3 hours	3.1	4.0	4.7	5.4	6.2	6.9	8.3
6 hours	3.6	5.3	6.2	6.7	7.5	8.4	10.2
12 hours	4.2	5.8	6.8	8.2	9.3	10.5	13.0
24 hours	4.9	6.7	8.3	9.6	11.0	12.5	15.5
2 days	5.7	7.5	9.3	10.9	12.5	14.3	17.6
4 days	6.6	8.9	10.4	12.5	14.5	16.0	19.9
7 days	7.6	10.0	11.9	14.2	16.2	17.9	22.2

> 800

35.2

Table 4
Intensity Duration Frequency for Fort Bend County

HURRICANE HARVEY
Record Storm - 2017

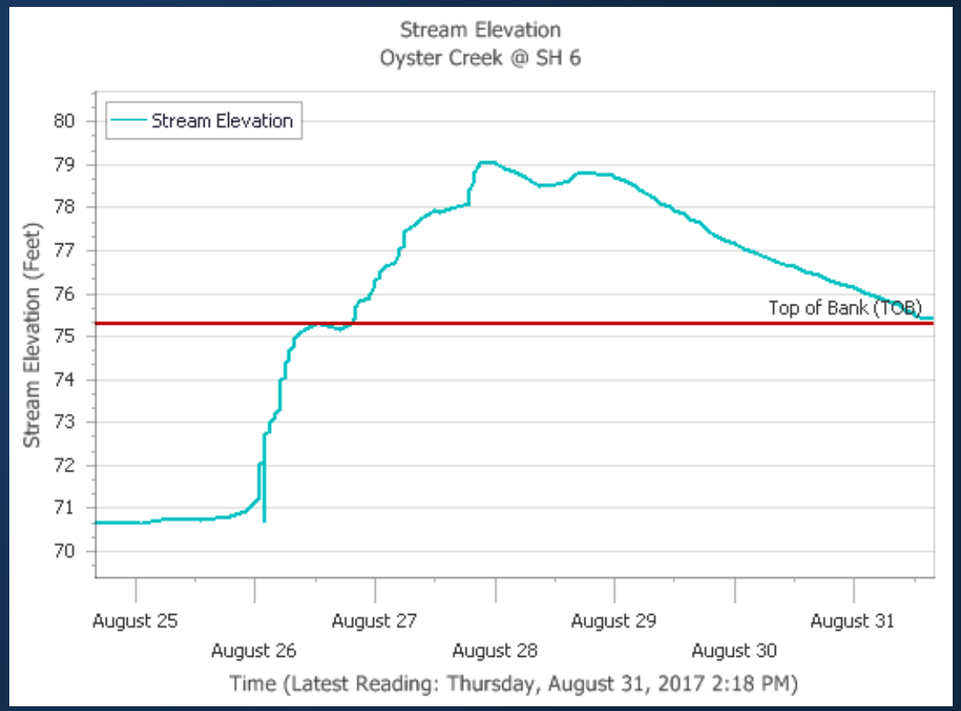


HURRICANE HARVEY FACTS

- 26.3” of rain in CoSL between 8/25 and 8/27
- LIDs Gates started closing between 8/27 at 7:45 PM and 8/28 at 1:00 AM
- 9.4” of rain pumped between 8/27 and 9/6
- Pumping capacity of LIDs: 80,000 to 241,800 GPM

HURRICANE HARVEY FACTS

- Oyster Creek
  - Flow outside banks between August 26 and August 31
  - Dams and outfall structures performed as designed.
  - Ditch H outfall
  - AMIL Gates
  - Central Unit Area flooded
  - And Airport runway



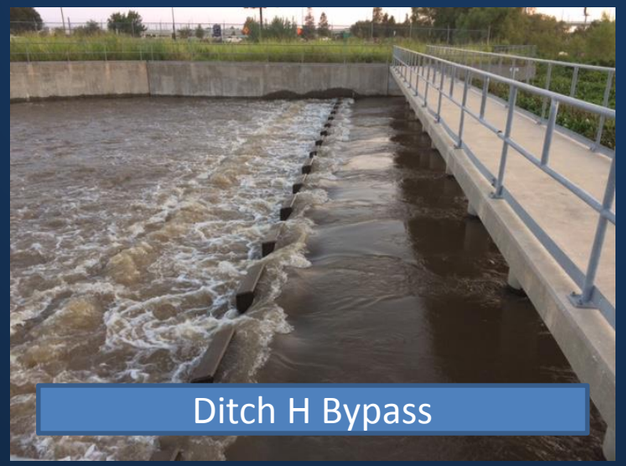
HURRICANE HARVEY FACTS

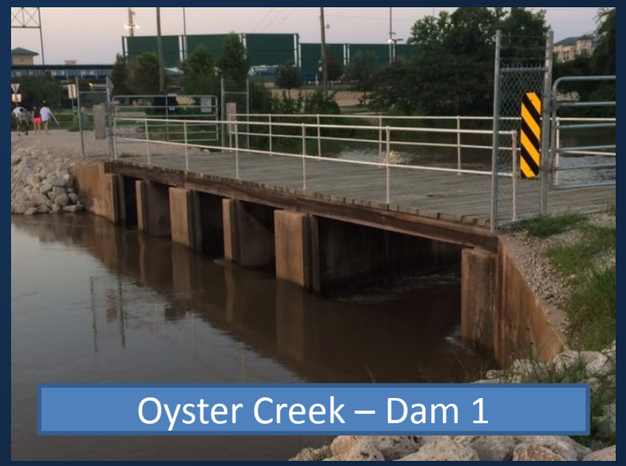

Oyster Creek


Oyster Creek – Dam 3


Oyster Creek – Dam 2

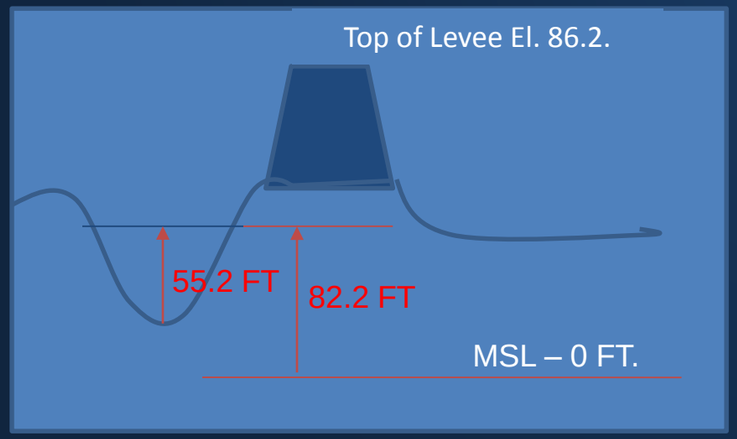

Oyster Creek – Amil Gates

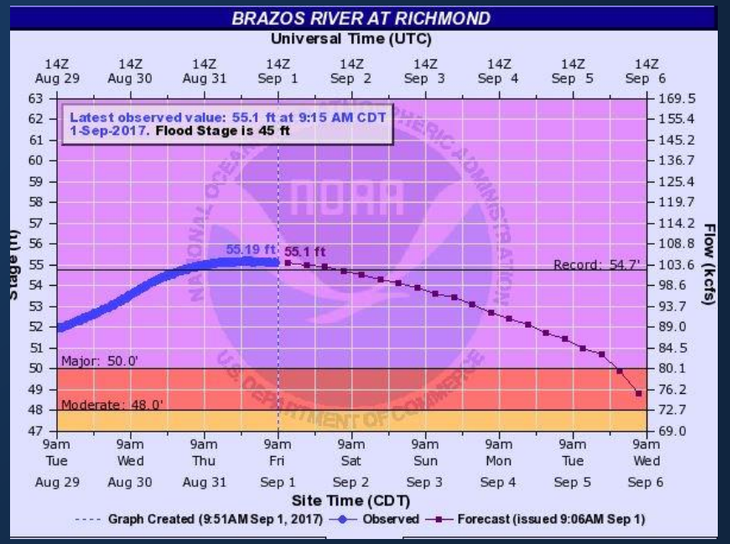

Ditch H Bypass


Oyster Creek – Dam 1

HURRICANE HARVEY CLASSIFICATION

- **Coincidental Event**
  - **Brazos River :**
    - **New Record Elev.: 55.2 ft. @ Richmond on 9/1/17**
    - **MSL: 82.2 ft. (NAVD 1988)**
    - **1% FEMA (100 yr.): 82.8 ft.**





HURRICANE HARVEY CLASSIFICATION

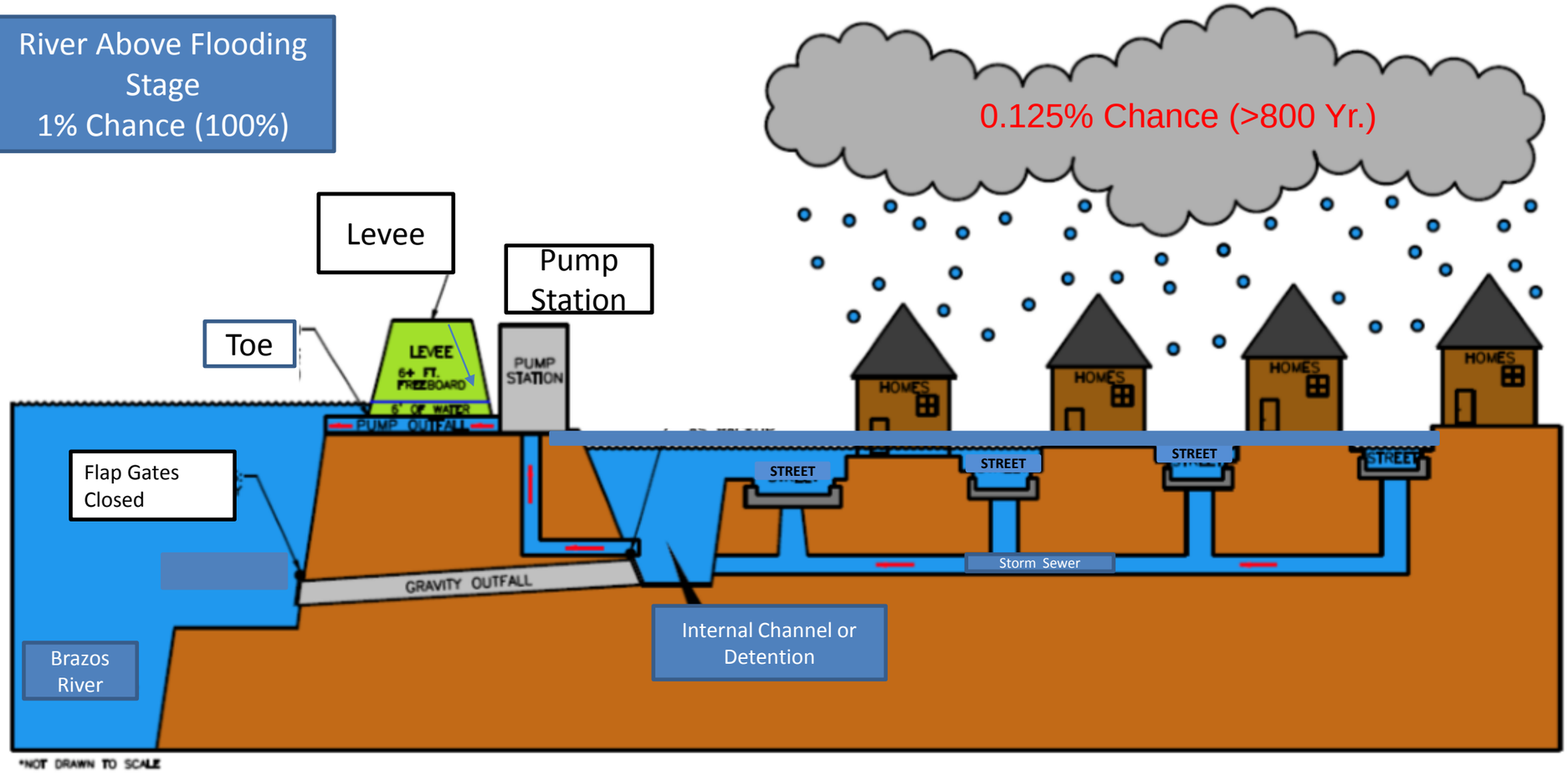
- **Coincidental Event**
  - **CoSL Internal Rainfall:**
    29.5 to 35.2 in of Rain
    < 0.125% chance (>800-yr)

Duration	Return Frequency (years)						
	2	5	10	25	50	100	500
30 minutes	1.9	2.3	2.7	3.0	3.5	3.8	4.6
60 minutes	2.3	2.7	3.3	3.8	4.2	4.6	5.5
2 hours	2.8	3.1	4.3	4.9	5.4	6.1	7.4
3 hours	3.1	4.0	4.7	5.4	6.2	6.9	8.3
6 hours	3.6	5.3	6.2	6.7	7.5	8.4	10.2
12 hours	4.2	5.8	6.8	8.2	9.3	10.5	13.0
24 hours	4.9	6.7	8.3	9.6	11.0	12.5	15.5
2 days	5.7	7.5	9.3	10.9	12.5	14.3	17.6
4 days	6.6	8.9	10.4	12.5	14.5	16.0	19.9
7 days	7.6	10.0	11.9	14.2	16.2	17.9	22.2

Table 4
Intensity Duration Frequency for Fort Bend County

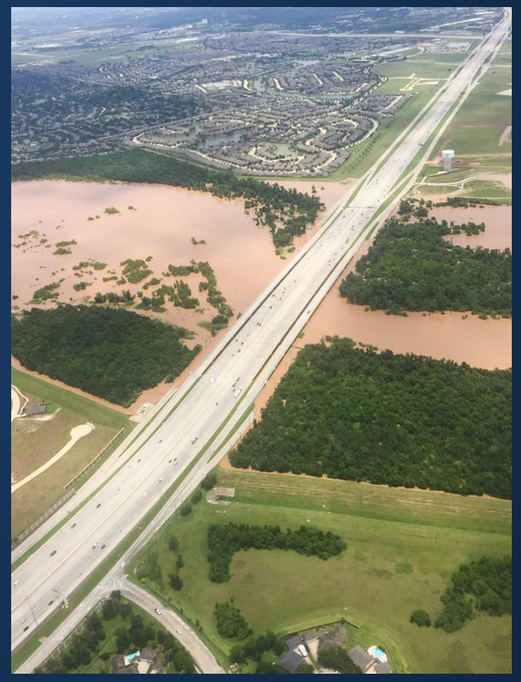
COINCIDENTIAL EVENT OPERATIONS
Hurricane Harvey

River Above Flooding Stage
1% Chance (100%)



HARVEY IMPACT ON THE CITY

- **NUMBER OF STRUCTURES FLOODED BY BRAZOS RIVER WITHIN CITY LIMITS : None**

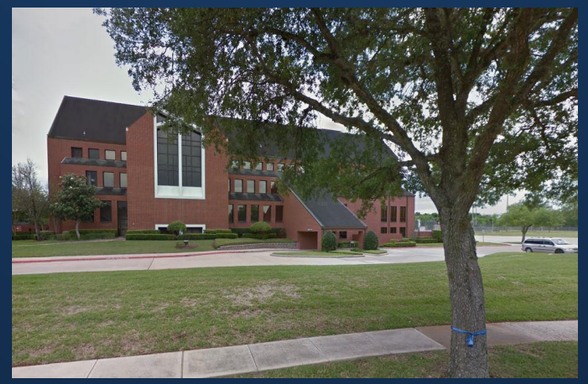


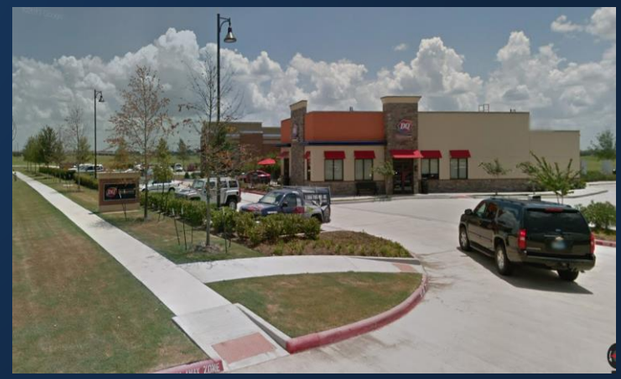
HARVEY IMPACT ON THE CITY

- **NUMBER OF STRUCTURES FLOODED BY RAIN:**
  - **Homes:**
    230 in FBC LID #2 (2” to 6”)
    17 Outside LIDs

  - **Businesses: 4**

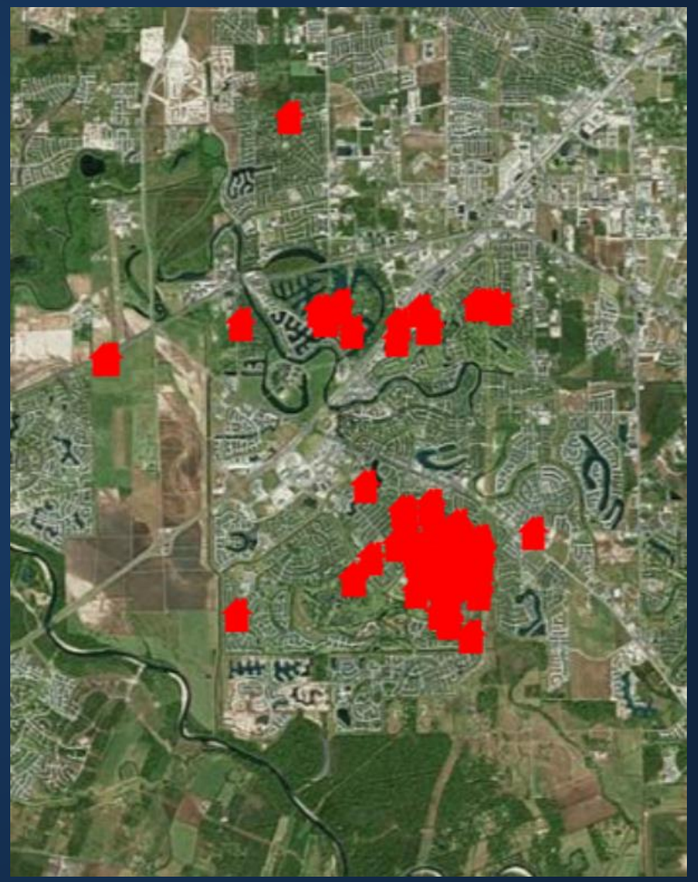
  - **Institutional: 1**





HARVEY IMPACT ON THE CITY

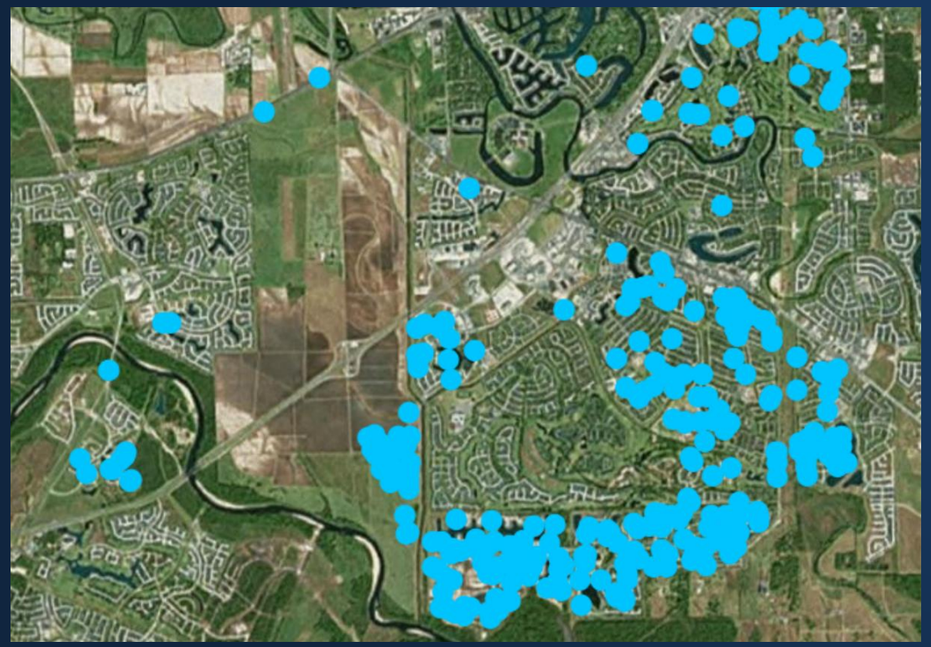
- **CoSL FLOODED AREAS**

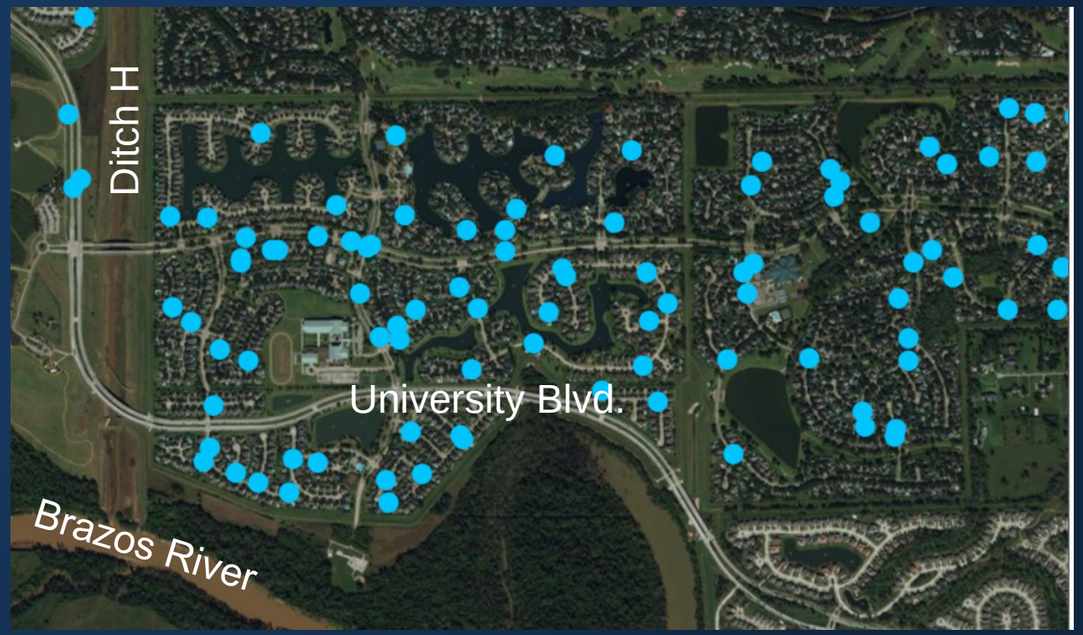


http://cosl.maps.arcgis.com/home/index.html

HARVEY IMPACT ON THE CITY

- **CoSL Street Ponding**





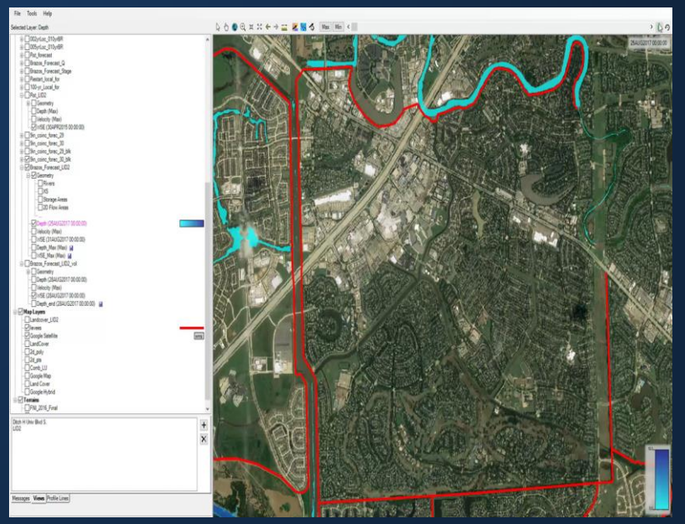
HARVEY IMPACT ON THE CITY

- **WHY THESE AREAS EXPERIENCED FLOODING**
  - **Excessive rainfall inside the Levees after river gates closed**
  - **Pumps design capacity was exceeded in several LIDs**
  - **System design criteria exceeded by Harvey event (total rainfall and timing)**

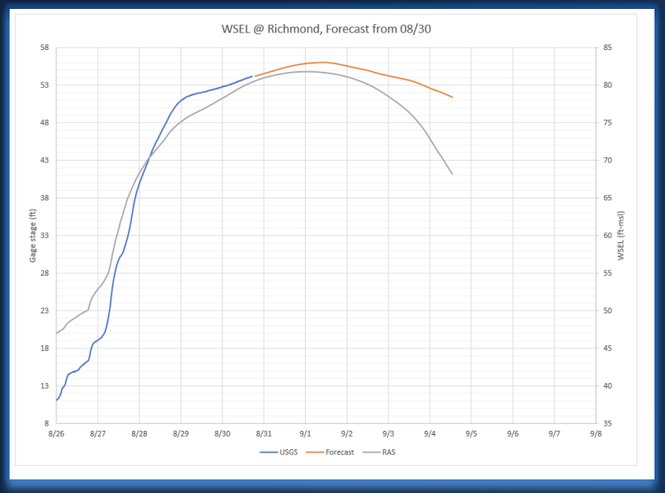
- **EXPLANATION OF ISOLATED FLOODING**
  - **Backyard, Foundation, etc.**
  - **Design Criteria exceeded by Harvey event**

ENGINEERING DEPARTMENT RESPONSE

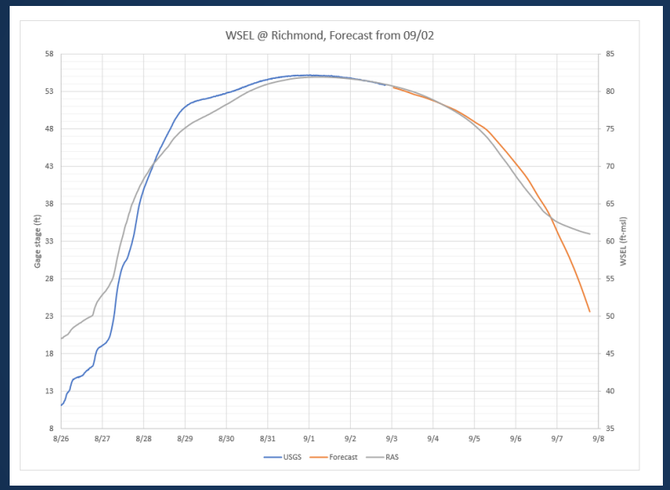
- **BEFORE THE STORM**
  - **Modeling Work**
    - **Inundation Maps**
    - **Oyster Creek Model**
    - **Brazos River Models**



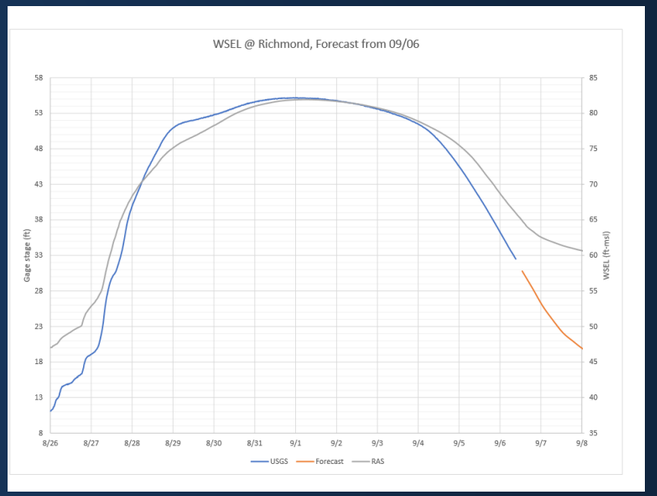
Brazos River Model Predictions



Predicted Peak on 8/30



Predicted Stage on 9/02



Predicted Stage on 9/06

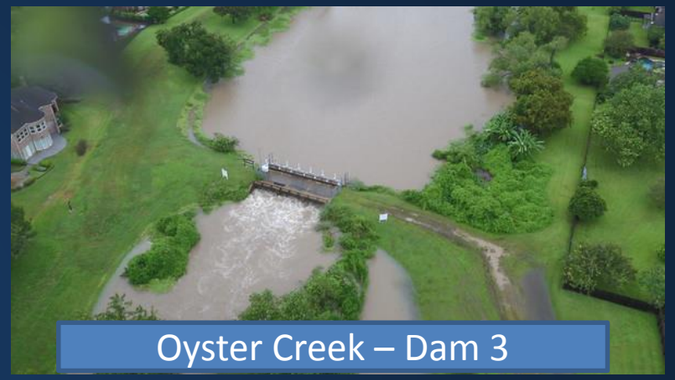
ENGINEERING DEPARTMENT RESPONSE

- **DURING THE STORM**
  - **Monitor Brazos River and Oyster Creek Flood Stage**
  - **Monitor rainfall and street ponding around the City**
  - **Run predictions models for Brazos river and Oyster Creek**
  - **Run inundation maps based on actual rain and flood elevations**
  - **Coordinate with Public Works, PD, FD and other City Departments**

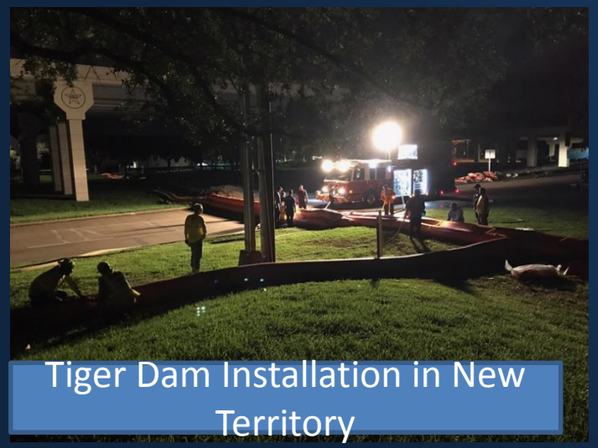
ENGINEERING DEPARTMENT RESPONSE

EOC – Engineering Coordination

Commonwealth Blvd

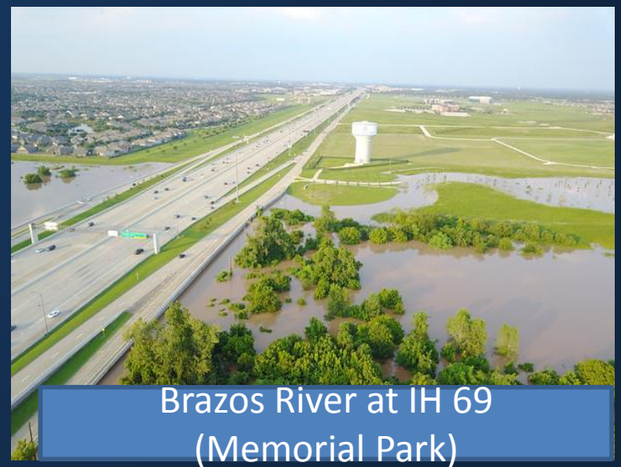


Oyster Creek – Dam 3



Tiger Dam Installation in New Territory

Ditch H at Pumps Station A



Brazos River at IH 69 (Memorial Park)

ENGINEERING DEPARTMENT RESPONSE

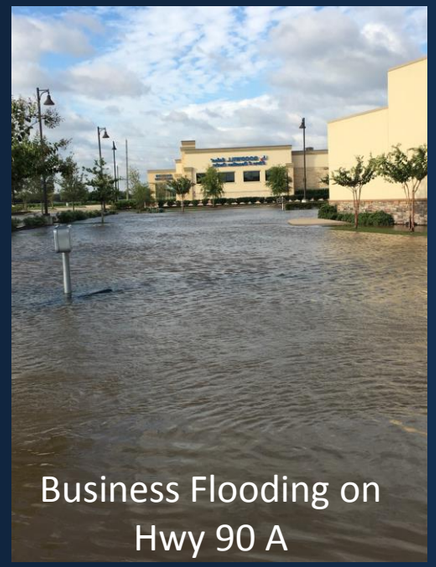
- Communication with County and LIDs
  - Attend Fort Bend County EOC Meeting daily
  - Daily conference calls with each LID
  - Shared information regarding:
    - LIDS Operation Status
    - Street Conditions
    - Oyster Creek and Brazos River Status

ENGINEERING DEPARTMENT RESPONSE

- AFTER THE STORM
  - High water marks determination
  - Preliminary modeling efforts
  - Identification of all impacted areas (Field Work)
  - Work with impacted residents for permission to collect:
    - Slab Elevations
    - High water mark elevations
    - Information to help establish the time that property was flooded
    - Online Self-report
    - ArcGIS Collector

ENGINEERING DEPARTMENT RESPONSE

- **AFTER THE STORM**



Business Flooding on Hwy 90 A

Street Ponding on Elkins and Commonwealth

Street Ponding on Austin Parkway

ENGINEERING DEPARTMENT RESPONSE

- **AFTER THE STORM**

GIS Collector


Identification of flooded Properties


High Water Marks Determination


Identification of flooded Properties


High Water Marks Determination

JOIN STUDY WITH FBC LID # 2

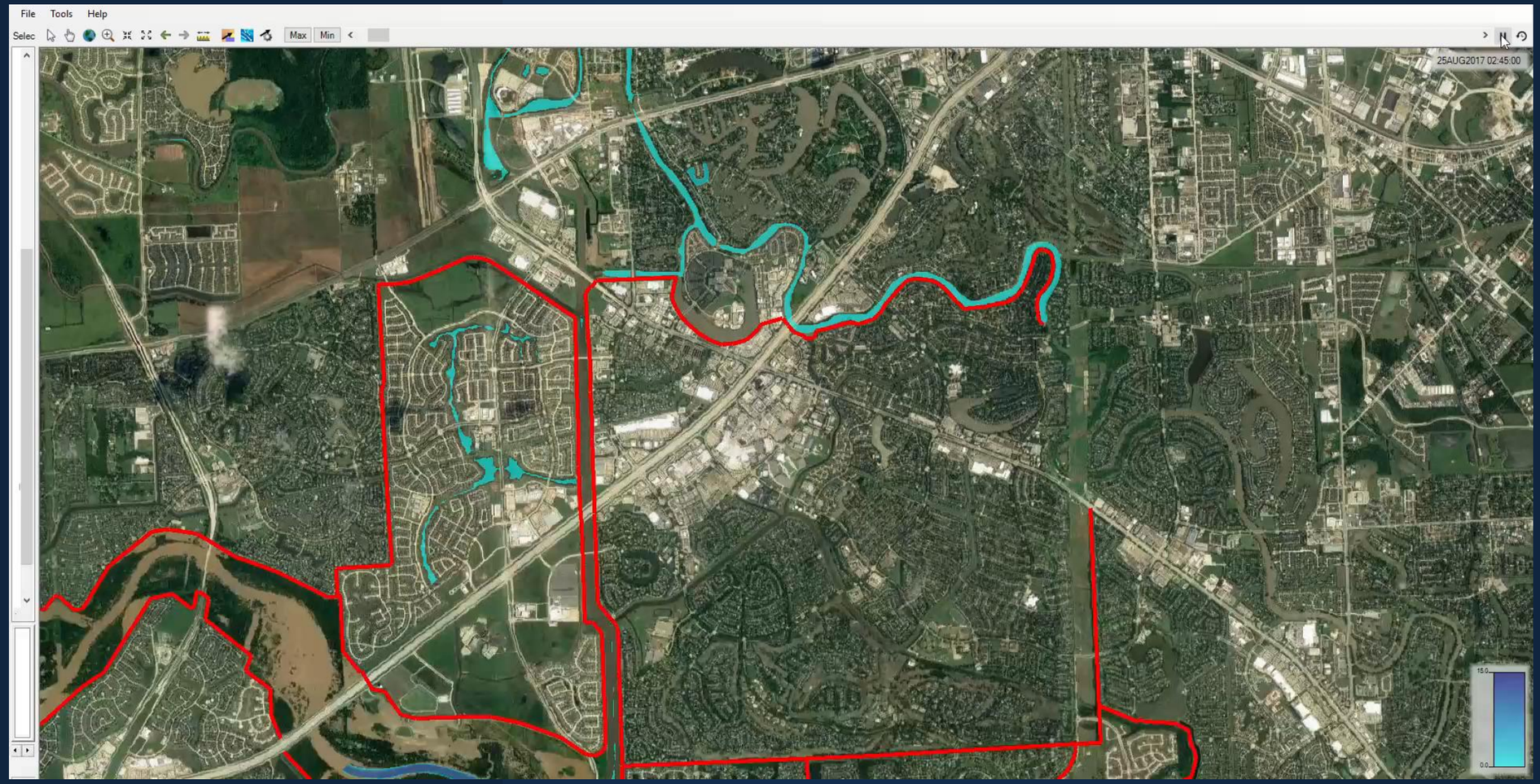
- **AFTER THE STORM STUDY (9/15/2017)**
  - **Hold public meetings with residents**
  - **Determine possible actions to prevent structural flooding from occurring in the future**
  - **Prepare engineering reports and present the findings to all affected home owners at a future public meeting**
  - **Identify combined improvement projects with LIDs and within our City’s Capital Improvements Program**

ENGINEERING DEPARTMENT RESPONSE

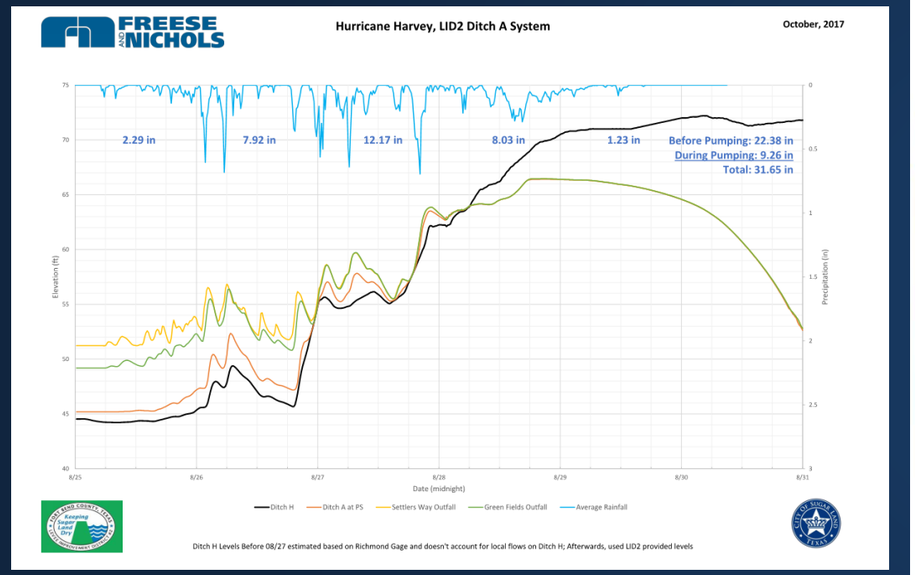
- **MEETINGS WITH RESIDENTS**

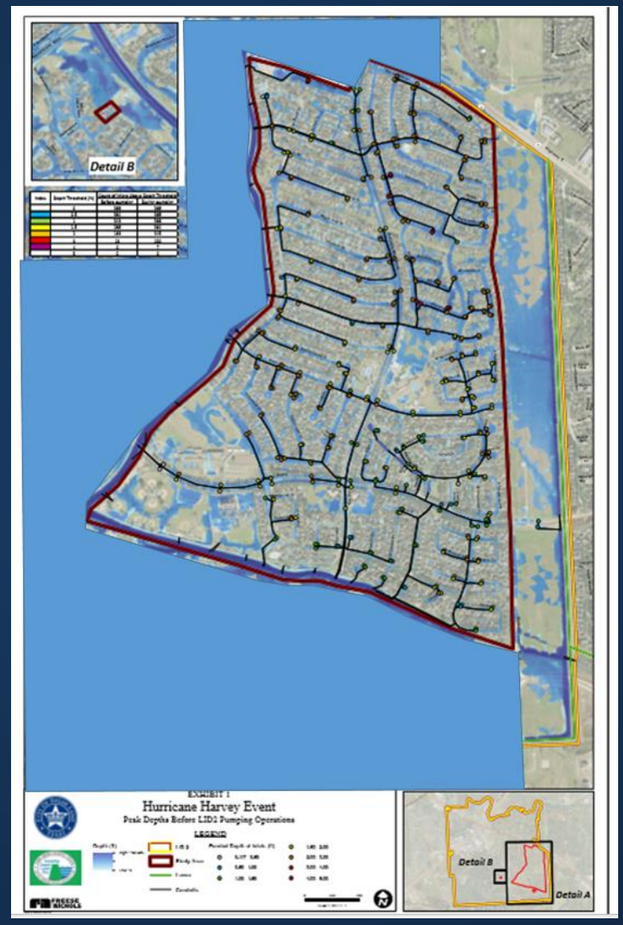
  - **September 11: Chimney Stone HOA general meeting**
  - **September 11: Brookside Belknap HOA meeting**
  - **September 11: FBC LID #14 General Monthly Meeting**
  - **September 15: FBCLID #2 Conference Call**
  - **September 18: Riverstone LIDS**
  - **September 20: Settlers Park HOA Meeting**
  - **September 28: Resident Meeting Section 8 Sweetwater**
  - **October 5: FBC LID #14 Special District Meeting**
  - **October 16: FBC LID # 17 & LID #1 Special District Meeting**
  - **November 8: FBC LID #2 Meetings with Flooded Residents**
  - **November 14: FBC LID #2 General Meeting**

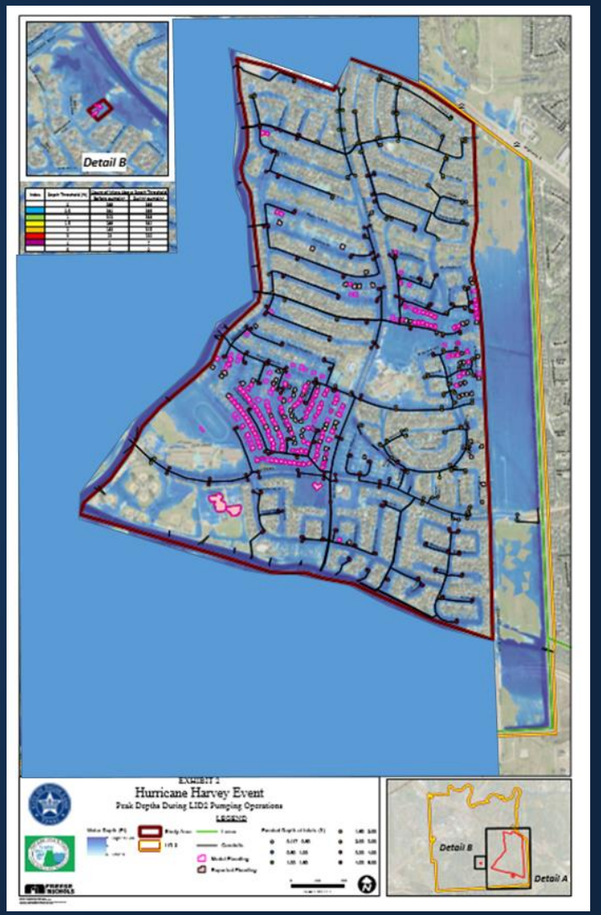
2-D MODELING



CoSL / FBC LID # 2
STUDY AND PRELIMINARY RESULTS







ONGOING EFFORTS AND MOVING FORWARD

- **CoSL / FBC LID 2 STUDY**
  - **CoSL and LID 2 will present the preliminary results to residents**
  - **CoSL and LID 2 will identify any possible drainage improvement**
  - **CoSL will present to City Council for implementation in future CIP**

- **COORDINATION WITH LIDs**
  - **City will work with other LIDS to mitigate the effects of similar storm events on the City**

ONGOING EFFORTS

1. ✓ Finalize the identification of all impacted properties
2. ✓ Map all impacted areas
3. ✓ Work with our impacted residents for permission to collect survey data for their property, Analyze all data to determine the cause of the flooding in each specific area
4. ✓ Hold a public meeting with residents about this event and the plan moving forward
5. ✓ Prepare engineering reports for each area and present the findings to all affected home owners at a future public meeting
6. Determine what actions might be possible to prevent this from occurring in the future
7. Include projects in City’s Capital Improvements Program
8. Begin work on future projects as identified with planning, LIDs and FB County

Questions